THE TAMPA BAY OIL SPILL: ASSESSING (Seagrass) FAUNAL IMPACT

submitted by

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INTRODUCTION

On August 10, 1993 an oil spill at the mouth of Tampa Bay was recorded. This report summarizes the findings from field sampling conducted in winter 1993-1994 of selected sites both in areas where oil was visually observed to be present in August 1993 and "control" sites which were not in close proximity to the spilled oil. A major focus of the study was organisms that live in the water column, e.g. fish, macroepifauna, and blade-dwelling meiofauna.

METHODS AND MATERIALS

Six sampling sites all from shallow seagrass areas were located in lower Tampa Bay, Florida (Figure 1). Observations made in August 1993 immediately after the oil spill suggested that Egmont Key was the site most directly affected by oil although an oil sheen was reported over the Ft. Desoto site. Additionally oil was present in the mangrove fringe surrounding the East Beach site. Bunces Pass, Skeet Key and Indian Key represent three "control" sites. Thalassia testudinum was the seagrass present at all sites except for Bunces Pass and Ft. Desoto where Halodule wrightii was dominant. All sites were sampled during midday December 14, 1993-January 27, 1994 (bad weather and rough seas repeatedly postponed

the Egmont Key sampling) and water depth ranged from 56 to 90 cm. Salinity of the water at time of sampling ranged from 30 to 34 o/oo and temperature ranged from 15 to 19 ^{o}C.

At each site samples were collected for fish, macroepifauna and blade dwelling meiofauna. Three throw traps (1mx1m area and 120 cm deep with 3.2 mm mesh opening) were haphazardly tossed into each site. From within each trap, three samples of seagrass blades were collected (n=9 per site) according to the methods of Hall (1988). Fish and macroepifauna were collected by dipnetting and seining both with a 3.2mm mesh net. Repetitive dipnetting was conducted until five dipnets in a sequence failed to capture any fish. Approximately 95% of all shrimp are also collected by this procedure (Bell and Fonseca, unpubl.). After dipnetting, the traps were seined until three successive passes when the seine failed to capture any fish. This technique efficiently captures both the macroepifauna and the small (15-60 mm standard length) size class of fish in seagrass beds. In addition to these samples, three benthic cores were collected from each trap and archived.

RESULTS and DISCUSSION

The most abundant macroepifauna taxa captured from all sites were "Gastropods and Hermit Crabs" and decapods (Table 1). Shrimp and crabs were dominant decapod groups in all sites. Hermit crabs and gastropods, taxa found both on blades and in sediments and not best sampled by dipnetting, were abundant at all sites except

Egmont Key. At Egmont Key, the oiled site, crab abundance was very low compared to the other control sites with Thalassia seagrass vegetation i.e. Indian Key and Skeet Key. In contrast, East Beach, the other oiled site had the highest decapod crab abundances of any site. East Beach had the lowest number of shrimp species of any site (only 2 different species were recorded) (Table 2) although abundances were higher than those at one "control" site (IK) (Table 1). In one East Beach sample an oil residue was present on seagrass and the preserved shrimp. Fourteen species of shrimp were recorded at Egmont Key and species composition overlapped with that of control sites (IK and SK) (Table 2). However proportional abundances of most numerous taxa varied among oiled and control sites. Alpheidae, Hippolyte zostericola, Latreutes fucorum and Periclemens longicaudatus were very abundant at Skeet Key but only H. zostericola and L. fucorum had high densities at Egmont Key.

Macroepifauna from Ft. Desoto, an oiled site with Halodule seagrass, had very low numbers of decapods and a reduced abundance of hermit crabs and gastropods compared to the control site, Bunces Pass (Table 1). Seven species of decapod shrimp were found at Ft. Desoto while 15 were recorded at Bunces Pass (Table 2). The two most abundant species at Bunces Pass, Hippolyte zostericola and Penaeus sp. were represented by one and no individuals, respectively, at Ft. Desoto. Thus Ft. Desoto not only had reduced numbers of macroepifauna but also a lower species richness and differing proportional abundances of major shrimp taxa.

Density of fish species and mean number of fish species were

highly variable among sites (Table 3). Among the sites with Thalassia vegetation, East Beach (an oiled site) harbored the highest densities of fish and fish abundance were similar among the remaining three sites. Unidentified fish, composed of juveniles ≤ 15 mm standard length were present at all sites but were the single most numerous fish taxa at Egmont Key and Skeet Key (Table 4). Species composition of East Beach and Egmont Key was very different from each other and from control sites as well. In contrast, all species of fish captured at Indian Key were also found at Skeet Key. When the two sites with Halodule vegetation are compared, it is clear that the fish fauna is both depauperate in abundance and diversity at the Ft. Desoto site compared to Bunces Pass (Tables 3 and 4).

At all sites meiofaunal copepods and nauplii were the most numerous meiofauna taxa on seagrass blades (Table 5). Ostracods and turbellarians were only rarely encountered and their abundances are reflected in total number of taxa. Total number of blade-dwelling meiofauna were similar between control sites where Thalassia vegetation was present (Table 5). Likewise, total number of meiofauna was strikingly similar between oiled sites (East Beach and Egmont Key) although much reduced compared to control sites. Both number of meiofaunal copepods and copepod nauplii per blade area were much lower at both Egmont Key and East Beach than at Indian and Skeet Keys (Table 5). As was true for the macroepifauna and fish, meiofaunal copepod and copepod nauplii densities were reduced at Ft. Desoto compared to Bunces Pass (Table

5). Overall there was a consistent trend of lower meiofaunal densities in oiled sites versus control areas.

Mean densities of fish from Ft. Desoto recorded during this study are lower than those reported from the same site in winter but in earlier years (Table 6). Inspection of data from Table 6 also suggests that fish density at Bunces Pass is within the range of densities previously recorded at this site. Thus the lower fish density at Ft. Desoto may not reflect natural variability. We have no data to determine whether the marked reduction in abundance and species richness of decapods at Ft. Desoto relative to control sites is also suggestive of impact by oil.

Comparison of meiofaunal densities at Ft. Desoto over several years indicates that the values recorded in winter 1993-94 after an oil spill are in fact higher than that reported from similar seasons in previous years (Table 6). Thus, although densities of meiofauna at Ft. Desoto are lower than the "control" site, such densities appear to be characteristic for this site. What remains unknown is whether densities at Ft. Desoto reflect unimpacted levels in winter 1993-94. Comparison of meiofauna data from this sampling with other available data for November-January dates (Hall and Bell, 1993) suggests that the densities for Egmont Key in January 1994 are among the lowest reported in previous studies. Hall and Bell (1993) reported a mean density of total copepods approximating 1.0-20.0 copepods/cm^2 blade surface and naupliar densities of approximately 7.5-15/cm^2 blade surface. The mean densities recorded in this study, were 1.2 and 0.9/ cm^2 blade

surface, respectively. Reduction of meiofaunal copepod densities at Egmont Key compared to 1) control sites in winter 1993-94 as well as 2) the same site in winter 1983-84 (Table 6) is noteworthy. At East Beach, meiofaunal densities were also reduced relative to control sites, providing consistent evidence of faunal reduction in oiled sites.

Because of the general lack of information on the oil-impacted sites prior to the oil spill in August 1993 it may be impossible to definitively establish the impact of the spill on faunal communities. As an alternative approach, more information on impacted sites could be gathered over subsequent years to possibly detect "recovery". Likewise it may be instructive to expand the number of control sites used in the study so that a more thorough assessment of faunal abundances and species composition at "unimpacted" sites can be gathered. Regardless, the data reported here and in Bell (1993) establish some broad differences in faunal assemblages between oil-impacted and "control" sites.

REFERENCES

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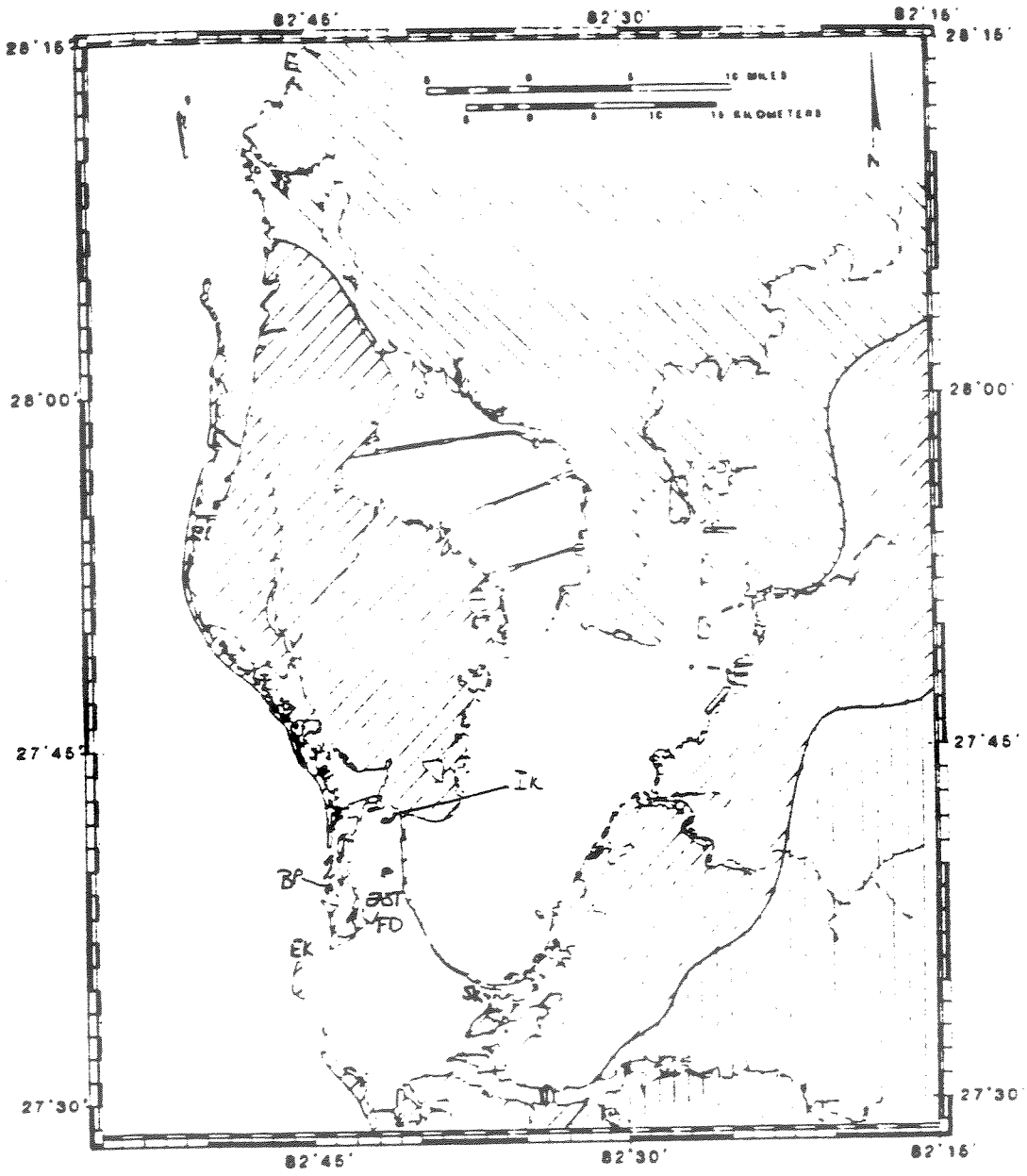

Figure 1. Location of six sampling sites in December 1993-January 1994.. EK=Egmont Key; IK= Indian Key; SK=Skeet Key; FD= Ft. Desoto, East=East Beach; BP=Bunces Pass.

Table 1. Abundance of major macroepifaunal taxa (#/m^2) in each of 3 replicate traps from 6 study sites, winter 1993-94.

SITE	MAJOR TAXA GAST,HER.	SHRIMP	CRABS	OTHER	TOTAL
Egmont Key					
1.	2	126	0	10	138
2.	4	131	3	12	150
3.	0	17	1	4	22
MEAN	2.0	91.3	1.3	8.6	103.3
SD	2.0	64.4	1.5	4.1	70.7
Skeet Key					
1.	71	82	4	2	159
2.	51	297	7	23	378
3.	86	140	9	2	237
MEAN	69.3	173	6.6	9.0	258
SD	17.5	111.2	2.5	12.1	111
East Beach					
1.	12	30	20	0	62
2.	15	53	34	1	103
3.	775	21	28	3	827
MEAN	267.3	34.6	27.3	0.3	330.6
SD	439.6	16.5	7.0	0.5	430.3
Indian Key					
1.	10	21	10	12	53
2.	186	15	7	3	211
3.	324	16	12	0	352
MEAN	173.3	17.3	9.6	5.0	205.3
SD	157.3	3.2	2.5	6.2	149.6

Table 1. Abundance of major macroepifaunal taxa (#/m^2) in each of 3 replicate traps from 6 study sites, winter 1993-94. (continued)

	MAJOR TAXA				
SITE	GAST,HER.	SHRIMP	CRABS	OTHER	TOTAL
Ft. Desoto					
1.	19	1	3	0	23
2.	1	4	0	3	8
3.	33	10	5	3	51
MEAN	17.6	5.0	2.6	2.0	27.3
SD	16.0	4.5	2.5	1.7	21.8
Bunces Pass					
1.	55	9	5	1	70
2.	57	24	5	2	88
3.	84	29	6	3	122
MEAN	65.3	20.6	5.3	2	93.3
SD	16.1	10.4	0.6	1	26.4

Table 2 . List of decapod shrimp species at six sampling stations in winter 1993-94. BP=Bunces Pass, FDS= Ft. Desoto, EB=East Beach, EG= Egmont Key, IK=Indian Key, SK-Skeet Key.

SITE	SPECIES	# INDIVIDUALS
BP	ALPHEIDAE	1
	Anchistioides antiguensis	2
	Brachycarpus biunguiculatus	2
	Hippolyte zostericola	16
	Latreutes fucorum	1
	Latreutes parvulus	1
	Palaemon northropi	2
	Parapenaeus americanus	3
	Penaeus sp.	11
	Periclemenes longicaudatus	1
	Processa bermudensis	2
	Processa fimbriata	4
	Pseudocheles chacei	4
	Trachypenaeus sp.	1
	Tozeuma carolinese	7
	TOTAL NUMBER OF SPECIES	15
FD		
	Hippolyte zostericola	1
	Latreutes fucorum	1
	Latreutes parvulus	1
	Metapenaeopsis goodei	1
	Palaemonetes pugio	2
	Processa fimbriata	7
	Tozeuma carolinense	1
	TOTAL NUMBER OF SPECIES	7
EB	Palaemon northropi	35
	Palaemonetes paludosus	68
	TOTAL NUMBER OF SPECIES	2

Table 2 . List of decapod shrimp species at six sampling stations in winter 1993-94. BP=Bunces Pass, FDS= Ft. Desoto, EB=East Beach, EG= Egmont Key, IK=Indian Key, SK-Skeet Key. (continued)

SITE	SPECIES	# INDIVIDUALS
EG	ALPHEIDAE	2
	Anchistoides antiguensis	2
	Gnathophylloides mineri	1
	Hippolyte zostericola	67
	Latreutes fucorum	123
	Latreutes parvulus	6
	Leptochela serratorbita	1
	Metalpheus rostratipes	1
	Penaeus sp.	5
	Periclemenes caraibicus	12
	Periclemenes sp.	5
	Processa sp.	1
	Sicyonia laevigata	2
	Tozeuma carolinense	42
	TOTAL NUMBER OF SPECIES	14
IK	Alpheidae	11
	Hippolyte zostericola	4
	Latreutes fucorum	1
	Latreutes parvulus	2
	Palaemon northropi	1
	Penaeus sp.	12
	Processa fimbriata	2
	Processa hemphilli	1
	Pseudocheles chacei	15
	Sicyonia laevigata	2
	TOTAL NUMBER OF SPECIES	10
SK	ALPHEIDAE	132
	Hippolyte zostericola	334
	Latreutes fucorum	64
	Latreutes parvulus	7
	Palaemon northropi	2
	Penaeus sp.	2
	Periclemens longicaudatus	61
	Processa fimbriata	19
	Sicyonia laevigata	6
	Thor dobkini	11
	TOTAL NUMBER OF SPECIES	10

Table 3. Mean number (SD) of fish and mean number(SD) of fish species per $1m^2$ dropnet at six study sites.

Site	Mean # individuals	Mean # of species
East Beach	49 (3.6)	3.6 (.5)
Egmont Key	18.6 (18.5)	2.6 (1.5)
Indian Key	16.3 (11.5)	3.0 (1)
Bunces Pass	12.6 (5.1)	4.6 (2.8)
Skeet Key	33.7 (21.6)	3.0 (1)
Ft. Desoto	3.0 (4.3)	1.0 (1)

Table 4. Fish species found at each sampling site, ranked in order of abundance. Unid= fish < 15 mm standard length.

East Beach	Gambusia affinis
	Cynoscion nebulosus
	Unid.
	Lagodon rhomboides
	Syngnathus scovelli
Egmont Key	Unid.
	Lagodon rhomboides
	Gobiosoma robustum
	Eucinostomus argenteus
	Bairdiella chrysoura
	Diplodus holbrooki
Indian Key	Gobiosoma robustum
	Microgobius gulosus
	Unid.
	Syngnathus scovelli
	Lagodon rhomboides
	Hippocampus zostera
Skeet Key	Unid.
	Symphurus plagiusa
	Gobiosoma robustum
	Syngnathus scovelli
	Microgobius gulosus
	Lagodon rhomboides
	Hippocampus erectus
	Chasmodes saburrae
Bunces Pass	Unid.
	Microgobius gulosus
	Syngnathus scovelli
	Gobiosoma robustum
	Eucinostomus argenteus
	Hippocampus zostera
	Lagodon rhomboides
	Symphurus plagiusa
	Gymnachirus texae
Ft. Desoto	Unid.
	Gobiosoma robustum
	Microgobius gulosus
	Sphoeroides parvus

Table 5. Mean (SD) density (# ind./cm^2) of dominant meiofauna taxa from six sampling sites in winter 1993-1994. FD= FT. Desoto, BP=Bunces Pass, EG=Egmont Key, SK=Skeet Key, EB=East Beach, IK= Indian Key.

	TAXA			
SITE	Nematodes	Copepods	Nauplii	TOTAL
FDS	0.9 (0.8)	0.7 (0.08)	0.6 (0.04)	2.5 (1.2)
BP	1.1 (0.3)	4.1 (0.8)	4.8 (1.0)	10.1 (10.2)
EG	0.21 (0.2)	1.2 (0.7)	0.9 (2.9)	2.4 (3.5)
SK	0.3 (0.2)	5.9 (1.6)	1.6 (0.1)	8.2 (0.3)
EB	0.2 (.06)	0.8 (0.7)	0.9 (0.1)	1.9 (0.7)
IK	2.7 (2.0)	3.0 (1.4)	2.3 (2.3)	8.1 (1.6)

Table 6. Comparison of fish and meiofauna copepod data from previous winters (November-January) in Tampa Bay with that of present study. Numbers for meiofauna and fish from Bunces Pass and Ft. Desoto are from Bell (unpubl). Data from Egmont Key are approximated from Hall and Bell (1993).

Fish Abundance (#/m^2)

Bunces Pass:	Nov. 1987	10.2	
	Nov. 1988	14.3	
	Nov. 1989	18.0	
	Nov. 1990	17.6	
	Nov. 1991	15.0	
	Dec. 1993	12.6	(this study)
Ft. Desoto:	Nov. 1990	5.0	
	Nov. 1991	5.3	
	Dec. 1993	3.0	(this study)

MEIOFAUNA ABUNDANCE (#/cm^2 blade surface)

Bunces Pass:	Nov. 1990	2.4	
Halodule	Nov. 1991	2.1	
	Nov. 1992	2.9	
	Dec. 1993	4.1	(this study)
Ft. Desoto:	Nov. 1990	.57	
Halodule	Nov. 1991	.21	
	Nov. 1992	.35	
	Dec. 1993	.75	(this study)

Egmont Key:			
Thalassia	Adult Copepods		
	Dec.1983-Jan.1984	1.0-20.0	
	Jan. 1994	1.2	(this study)
	Nauplii		
	Dec.1993-Jan.1994	7.5-15	
	Jan. 1994	0.9	(this study)